Amendments to the Specification:

Page 2, the last full paragraph, please replace with the following:

A second object of the present invention is to ~~provided~~ <u>provide</u> a noise adaptation system of speech model, a noise adaptation method, and a noise adaptation program for speech recognition that can provide improved speech recognition rates by using the result of the clustering.

Page 3, line 1, through page 6, line 12, please replace with the following:

~~According to claim 1~~ <u>In one aspect</u> of the present invention, there is provided a noise adaptation system of speech model for adapting a speech model for any noise to speech to be recognized in a noisy environment, the speech model being learned by using clean speech data, the system comprising: clustering means for clustering noise-added speech; speech model space generating means for generating a tree-structure noisy speech model space based on the result of the clustering performed by the clustering means; parameter extracting means for extracting a speech feature parameter of input noisy speech to be recognized; selecting means for selecting an optimum model from the tree-structure noisy speech model space generated by the speech model space generating means; and linear transformation means for applying linear transformation to the model selected by the selecting means so that the model provides a further increased likelihood. Because noise-added speech is consistently used both in the clustering process and model learning process, optimal clustering for many type

of noise data and an improved accuracy of estimation of speech model sequence of input speech can be achieved.

According to ~~claim 2~~ an embodiment of the present invention, there is provided the noise adaptation system of speech model ~~according to claim 1,~~ wherein the clustering means generates the noise-added speech by adding the noise to the speech in accordance with a signal-to-noise ratio condition, subtracts the mean value of speech cepstral of the generated noise-added speech, generates a Gaussian distribution model of each ~~of pieces~~ piece of generated noise-added speech, and calculates the likelihood between the pieces of noise-added speech to generate a likelihood matrix to provide a clustering result. This allows noise-added speech to be clustered.

According to ~~claim 3~~ another embodiment of the present invention, there is provided the noise adaptation system ~~according to claim 1 or 2,~~ wherein the selecting means selects a model that provides the highest likelihood for the speech feature parameter extracted by the parameter extracting means. By selecting the model that provides the highest likelihood, the accuracy of speech recognition can be improved.

According to ~~claim 4~~ a further embodiment of the present invention, there is provided the noise adaptation system ~~according to claim 3,~~ wherein the selecting means selects a model by searching the tree-structure noisy speech model space downward from the highest to the lowest level. By searching the

tree structure from the highest level to the lowest level, an optimum model can

be selected.

~~According to claim 5~~ In another embodiment of the present invention,

there is provided the noise adaptation system ~~according to one of the preceding~~

~~claims,~~ wherein the linear transformation means performs the linear

transformation on the basis of the model selected by the selecting means to

increase the likelihood. By performing the linear transformation, the likelihood

can be maximized.

~~According to claim 6~~ In another aspect of the present invention, there is

provided a speech model noise adaptation method for adapting a speech model

for any noise to speech to be recognized in a noisy environment, the speech model

being learned by using clean speech data, the method comprising: a clustering

step of clustering noise-added speech; a speech model space generating step of

generating a tree-structure noisy speech model space based on the result of the

clustering performed at the clustering step; a parameter extracting step of

extracting a speech feature parameter of input noisy speech to be recognized; a

selecting step of selecting an optimum model from the tree-structure noisy

speech model space generated at the speech model space generating step; and a

linear transformation step of applying linear transformation to the model

selected at the selecting step so that the model provides a further increased

likelihood. Because noise-added speech is consistently used both in clustering

and model learning, an improved accuracy of estimation of a speech model sequence of input speech can be achieved.

According to ~~claim 7~~ a variation of the present invention, there is provided a noise adaptation program for speech recognition that controls a computer to adapt a speech model for any noise to speech to be recognized in a noisy environment, the speech model being learned by using clean speech data, the program comprising: a clustering step of clustering noise-added speech; a speech model space generating step of generating a tree-structure noisy speech model space based on the result of the clustering performed at the clustering step; a parameter extracting step of extracting a speech feature parameter of input noisy speech to be recognized; a selecting step of selecting an optimum model from the tree-structure noisy speech model space generated at the speech model space generating step; and a linear transformation step of applying linear transformation to the model selected at the selecting step so that the model provides a further increased likelihood. Because noise-added speech is consistently used both in clustering and model learning, an improved accuracy of estimation of a speech model sequence of input speech can be achieved.

Page 20, line 1, through page 21, line 2, please replace with the following:

As has been described, ~~according to claims, 1, 6, and 11 of the present invention,~~ the present invention has advantages that, because noise-added speech is consistently used both in the clustering and model learning processes,

optimal clustering for many types of noise data and an improved accuracy of estimation of a speech model sequence for input speech can be achieved.

~~According to claim 2 of the present invention, the~~ The present invention has an advantage that noise-added speech can be clustered by adding noise to the speech in accordance with signal-to-noise ratio conditions, subtracting the mean value of speech cepstral of each of the pieces of generated noise-added speech, generating a Gaussian distribution model of each of the pieces of noise-added speech, and calculating the likelihood between the pieces of noise-added speech to generate a likelihood matrix.

~~According to claim 3 of the present invention, the~~ The present invention has an advantage that an improved accuracy of speech recognition can be achieved by selecting a model that provides the highest likelihood for an extracted speech feature parameter.

~~According to claim 4 of the present invention, the~~ The present invention has an advantage that an optimum model can be selected by searching the tree-structure noisy speech model from the highest to level for an optimum model.

~~According to claim 5 of the present invention, the~~ The present invention has an advantage that the likelihood can be maximized by performing linear transformation on the basis of the selected model so as to increase the likelihood.